HOW TO SAVE MONEY,
PROTECT YOUR HEALTH
AND HELP THE PLANET

STAY WARM IN AN ENERGY EFFICIENT HOME

Did you know that more than $1 billion each year is spent by New Zealand households just to keep warm, heat water and run appliances? That's about $1,800 on gas, electricity & fuel bills for every home.

The energy that New Zealanders use to heat their homes, heat water and run appliances accounts for about 12 percent of the country's total energy use.

Much of this energy can be saved. There are simple steps you can take to save money on energy and have a warmer, drier and healthier home at the same time.

You will also help the environment. It's a common belief that all New Zealand's energy is generated by renewable sources, such as hydro and wind power.

In fact, one dollar in three of your power bill comes from burning coal, gas and oil to generate electricity. This creates greenhouse gases that cause the Earth to heat and the climate to change.

This handout, written for Sustainable Living Programme with 2007 input from the Dept of Building and Housing, offers practical tips and strategies that can help you improve the energy efficiency of your home. It will help you be more confident discussing insulation, heating and other techniques to make your home more energy efficient, when talking with your builder, supplier, architect or local council.

With an energy efficient home, you will have more money in your pocket that you have saved on heating, can improve your family's health and help sustain the planet.

INSULATION

The most significant step you can take to improve the energy efficiency and comfort of your home is to prevent heat loss (and keep your home cool in summer) with insulation.

A well-insulated home will provide year-round comfort, and cost less to cool and heat. Insulation also helps reduce noise levels and condensation.

Many New Zealand homes are cold, damp and expensive to heat. About half the homes in New Zealand have inadequate ceiling insulation and half have no floor or wall insulation.

These homes aren't just uncomfortable to live in; they're also bad for you. A Wellington School of Medicine study has found that families in uninsulated homes had more medical and hospital visits for respiratory conditions, and more days off work and school than those in insulated homes.

There are legal minimum requirements for insulation in new homes and additions to existing homes, but it's worth spending a little more to exceed these requirements and get a warmer, more comfortable home.

While there are no specific requirements for existing homes, installing or upgrading your insulation is one of the best investments you can make.

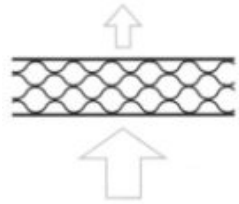
Types of insulation

Insulation works by reducing the transfer of heat by means of a barrier.

There are two main types of insulation.

Bulk insulation materials use small, trapped air pockets to reduce or prevent heat flow. The air does the insulating; the material simply traps it.

Bulk insulation comes in a variety of formats - blankets, segments, rigid sheets or loose fill. Fibreglass batts and wool or polyester blankets are examples of bulk insulation.

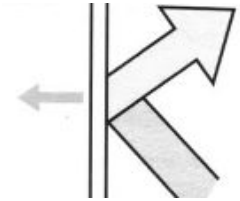


Bulk insulation traps air in still layers, reducing heat conduction and convection.

Reflective insulation works by letting through only a small percentage of the radiant heat it receives and reflecting the rest using a shiny surface. A gap next to the reflective surface creates a still layer of air, which is important for reducing heat flow.

Reflective insulation comes as flexible metallic foils with either one or both sides reflective, as single or multiple layers. It should be perforated to improve movement of moisture away from surfaces.

Some insulation materials combine bulk insulation and reflective radiation. Under-floor foil (sisalation) is mostly reflective. Some window exterior tints are also reflective.



Reflective insulation reflects radiant heat.

Insulation performance

The measure of insulation is expressed as an R-value, which is a product's resistance to heat flow. The higher the R-value the more effective the insulation is in resisting heat transfer.

The most common R-value in new homes for walls and roofs is between R1.5 and R3.0. Higher R-values are required in colder parts of New Zealand, although you can install higher R-values than the required legal minimum for more comfort and energy savings.

The extra cost of installing better insulation can be offset by savings in energy costs.

When choosing, consider products which:

- are non-combustible/fire resistant
- are vermin resistant
- stay mould-free/will not rot
- make homes quieter
- perform over time
- come with a Building Research Association of New Zealand (BRANZ) appraisal
- are easy to fit if you are doing it yourself
- are non-toxic/non-irritant
- won't sag over time
- breathe.

Find out more about insulation:
http://www.smarterhomes.org.nz/materials/insulation-materials/

www.level.org.nz/passive-design/insulation/

Find out more about insulation ratings:
www.smarterhomes.org.nz/design/insulation/#4

The BRANZ Annual Loss Factor calculator (ALF, version 3) is a software program which helps estimate and assess your insulation and heating requirements. To read about or install this, go to: www.branz.co.nz/alf

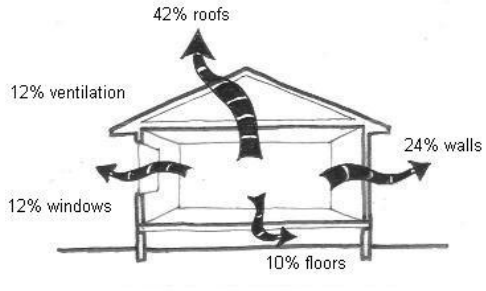
Where to place insulation

Most New Zealand homes are built of timber framing, which is good for earthquake resistance but poor at retaining heat. In an uninsulated timber house (pre 1978), two-thirds of heat is lost through the ceiling and exterior walls.

The most heat is lost through the ceiling and roof, so that should be your top priority for insulation.

The design and construction of your home will affect the specific types of insulation you can use, and where the insulation can be placed.

Some construction systems, such as aerated concrete blocks, hollow glass blocks and straw bales are more effective at retaining heat, and relatively little additional insulation may be required.



Sources of heat loss in an uninsulated timber home

<u>Roof and ceiling insulation</u>

Roof-space and room ceilings work most effectively if they are all insulated together. About 42% of heat loss from an average uninsulated home occurs through this area (up to 60% in pre-1978 houses).

Use reflective insulation under the roof timbers (if accessible[1]) and bulk insulation such as fibreglass, polyester or wool Batts in the ceiling. Rolling bulk blanket insulation across ceiling joists is the most effective way to insulate the ceiling, as it covers the 'cold bridges' of the timber joists.

Wall insulation

About 24% of heat from an un-insulated timber home is lost through the walls. Walls can be more difficult to insulate than ceilings, particularly in existing homes.

If you're using a framed construction system, insulation should be placed within the wall framing. Insulation can also be installed outside the framing (but the insulation must be weatherproof to be effective).

The amount of insulation you can install may depend on the thickness of the walls and the size of the framing. If you're building a new home or major extension or renovation, consider increasing the framing size to fit in more insulation.

If you're using a solid construction system such as concrete, insulation should be placed on the outside of the solid wall if you need the heat storage capacity of the wall (thermal mass) or inside if you do not.
Wall insulation can be fitted to existing homes by:

- removing wall claddings and installing blanket or batt insulation - the best option for timber frames. Note that a building wrap will need to be installed to keep the insulation from contacting the cladding. See NZS 4246:2006.
- fixing solid or blanket insulation to the outside of solid walls. This will include external cladding as part of the system.

Floor insulation

Up to 20% of heat loss occurs through the floor in uninsulated houses. Underfloor insulation helps keep a home warm and dry. The most common material used is a double-sided reflective foil that is stapled along the floor joists.

PLEASE NOTE: It is best to use an approved installer because of the risk of electrocution if staples strike live cables.

Insulation should be used on the underside of suspended timber or concrete floors, or on the edge and underside of concrete floor slabs.

Polystyrene planks, which are cut to the width of floor between joists, are an effective and widely used type of insulation under timber floors.

Polystyrene 'pods' are available for concrete flooring, and expanded polystyrene insulation can be used in sandwich format between preformed concrete slabs and blocks. These may have poor performance however (see BUILD magazine, from BRANZ, Dec 2008 p 28)

[1] Reflective insulation can be hard to fit to the roof of an existing home unless you are replacing the roof.

Find out more about installing insulation:
www.level.org.nz/passive-design/insulation/installing-insulation/

Hot water

About 30% of your household's energy bill comes from heating water
Some of that energy can be lost before you get to use the water. Poorly insulated hot water cylinders and pipes lose heat, especially in winter when the surrounding air is colder.

Hot water cylinders

Electric storage cylinders are the most common form of water heating. When a hot water cylinder is insulated, less energy is used to keep the water warm.

Unfortunately, many New Zealand homes have older hot water cylinders that are poorly insulated. Newer electric hot water cylinders are A-grade and well-insulated. Check to see if *yours* has an A-grade sticker on it.

If the cylinder is not an A-grade, it probably feels warm to the touch. Invest in a cylinder wrap (see photo). It will repay itself in energy savings and you can still use the hot water cupboard to air clothes and linen. There are several types of wrap available, costing about $100 from DIY stores.

www.energywise.org.nz/yourhome/hotwater/hot-water-cylinder-wraps.html

Hot Pipes

Heat is also lost in hot water pipes while the hot water is flowing and while it is sitting in the pipe between uses.

Lagging, a type of foam or fiberglass wrap for pipes, can help prevent heat loss. Lagging should be installed on the portion of the hot water pipe from the cylinder to the pressure relief valve, and lower parts of the expansion/vent pipe. If accessible, all hotwater pipes should be insulated.

Find out more about hot water tank insulation:
www.level.org.nz/energy/water-heating/water-heating-supply-and-pipework/

Solar water heating

By harnessing the sun's energy to heat your water for two thirds of the year, you can minimize your electricity bills for water heating.

Solar panels on a North-facing roof absorb heat from the sun and use it to heat water directly or indirectly via an anti-freeze containing circuit (preferable in colder areas). The water is stored in a cylinder which might be placed on your roof (warm areas only), inside your roof space, or in a cupboard.

On winter days when there isn't enough sun to fully heat your water, some top-up heat will need to be supplied, using electricity, gas or perhaps heat from solid fuel in a wetback stove.

A recent Government initiative will make it easier to get a building consent for solar water heating, through a new Building Code Compliance Document.

Find out more about solar water heating:
www.smarterhomes.org.nz/energy/solar-water-heating/

www.solarsmarter.org.nz

Find out more about the Government solar water heating initiative:
www.dbh.govt.nz/energy-efficiency
And grants towards solar watrer heating installations:
http://www.energywise.govt.nz/funding-available/solar-and-heat-pump-water-heating-funding

Glazing

Windows and other glazed areas let in light and fresh air, but they also let heat & steam escape.

In a well-insulated home most heat escapes through windows and other glazing. Whether you're planning a new home, renovating or maintaining an existing home, you can minimise these problems by:

- choosing energy efficient glazing (such as double glazing or low-E glass), and
- making careful choices about the location, size and types of glazed areas in your home.

You'll need to consider climate, your home's orientation towards the sun, and other factors such as comfort, appearance and cost.

New Government requirements will mean double glazing is used in most new homes.
The type of frame can also affect the energy efficiency of your windows.

Aluminium is the most common framing material. While it is light, durable and low maintenance, aluminium is a poor insulator (metal conducts heat). Choose aluminium framing products with thermal breaks (which place insulation between the interior and exterior part of the frame), or aluminium combined with other materials.

Timber and uPVC are good insulators, but are less durable. Timber should be treated and sealed for weathertightness to reduce swelling and shrinkage when exposed to rain and sun. Timber needs regular maintenance.

Find out more about energy efficient glazing:
www.smarterhomes.org.nz/design/glazing/glazing-overview/

Find out more about window frame options:
www.smarterhomes.org.nz/design/glazing/frame-options/

Installation

Proper installation is critical for making sure insulation works properly. Most importantly, gaps and spaces must be avoided, as they will allow warm air to bypass the insulation.

A common example is steel wall framing which interrupts the insulation and acts as a thermal bridge. Heat loss along thermal bridges can be minimised by using thermal breaks**.** Material that does not conduct heat, for example polystyrene, is placed between the steel framework and the outside building material.

This is something your designer should know about. Compliance with the Building Code usually requires thermal breaks to be used when steel studs are used in wall construction.

You can fit some types of insulation, such as thermal blanket insulation, yourself. Don't install fiberglass without using gloves, mask and old clothes, as the fibres can float about! Installers are easy to find in the Yellow Pages. From 1 July 2009 all under-insulated homes built before 2000 will be eligible for Government subsidies on retrofitting insulation. See www.energywise.govt.nz/funding-available/index.html .
Energy Efficiency Community Network www.eecn.org.nz/index.html
(E.g. In Auckland: www.ecomatters.org.nz and in Wellington:
www.sustaintrust.org.nz/OurProjects/Current%20Projects/Energy_advice_main.htm)

New insulation requirements

Since 2008, new, higher insulation requirements in the Buiilding Code have resulted in new homes (and extensions to existing homes) using about 30% less energy to achieve comfortable indoor air temperatures.

Location	Average cost of constructing a medium-sized house pre changes	Average additional cost of construction after the changes	Annual saving in energy bills	Return period on investment (in years)
Auckland	$254,000	+$3000 - $5000	$760	7
Wellington	$253,000	+$3000 - $5000	$940	6
Christchurch	$251,000	+$3000 - $5000	$1340	4
Dunedin	$250,000	+$3000 - $5000	$1800	3

This assumes the entire house is heated to 16ºC all day, and the living areas are heated to 20ºC in the morning and evening. While this heating regime is greater than most New Zealanders currently follow, it is similar to measured heating regimes in new houses.

A word about energy efficiency

In a well-designed home, resources are conserved and used efficiently, in ways that keep your costs down without sacrificing comfort or convenience.

When designing and building a new home, or renovating an existing one, think about making your home more energy efficient from the outset.

Passive heating and natural light can reduce the amount of electricity or gas you use. So can solar water heating and energy efficient appliances. By using less energy, you'll save yourself money and you'll also help to reduce greenhouse gas emissions.

Heating water is the biggest part of the power bill in many New Zealand homes. By fitting low-flow showerheads and choosing water-efficient washing machines and other appliances, you'll use less hot water. Depending where you live, you may also pay less in water charges.

Typical household energy use

- Water heating 30%
- Heating 30%
- Refrigeration 10%
- Lighting 10%
- Other appliances (includes standby losses) 20%

Find out more about energy efficiency:
www.level.org.nz/energy/

www.smarterhomes.org.nz/energy/

HEATING

Traditional forms of heating are being replaced by newer, more energy-efficient approaches.

A warm home is vital for comfort and health. Yet many New Zealand homes aren't warm enough, and are below the World Health Organisation's recommended minimum indoor temperature of 18°C.

Heating is expensive (it typically accounts for about 30% of a household's annual energy consumption), and as energy prices rise it's likely to cost even more.

Most New Zealand homes use electricity, gas or wood for heat. But there are other options that can reduce your power bills and make your existing heating options more efficient.

The best, and cheapest, source of heat is the sun. A well-designed and oriented home will maximise the heat from the sun during the day, and retain that heat during the night.

Electric heaters

Electric heaters are portable and convenient. Oil-filled fin radiators are safer than radiant heat bars. Electric heaters are most useful if you want to provide warmth for a single person or a single room.

Radiant heaters have an element that shines warmth directly on to you. Convection heaters (which include fan heaters, panel heaters, and oil-filled column heaters) provide general background warmth. Using a fan means the room heats up more quickly and the heat is more even – but fans also use more energy.

For well-insulated homes, wall mounted panel heaters and oil-filled column heaters are good options. They can be run on timers, to heat only at morning and evening.

Gas heaters

Gas is an energy efficient form of heating. Approximately 80% of the energy in gas is turned into heat. Gas heaters can also provide high heat output relatively quickly.

Gas heaters can connect to your home's gas supply or run off LPG cylinders. Those that connect to your home's gas supply can either be fixed in place or portable.

Portable unflued gas heaters produce pollutants such as nitrogen dioxide, carbon monoxide and carbon dioxide that can be a significant health risk. They also produce a lot of water vapour (about one litre an hour) which increases condensation and the spread of mould and dust mites. This is another reason to not use unflued gas heaters. They are banned in many countries.

Open fires

Open fires are a traditional source of heat in New Zealand homes. While open fires are appealing visually, they're inefficient and there are environmental drawbacks. Because most of the heat goes up the chimney (85% wasted), instead of into your home, they require more fuel than really necessary to warm a room. They can also spark and be a fire hazard. A glass-door woodburner still has 'live flame' appeal.

Open fires produce a lot of smoke, which can be a health hazard both indoors and outdoors. Many cities and towns internationally have banned them.

Woodburners and pellet burners

Modern, enclosed woodburners are much more efficient than open fires. Wood is a renewable fuel and as long as the wood burned is replaced with growing trees, it's carbon neutral. If you have a free supply of dry, untreated timber, woodburners are among the cheapest heating options available.

However, woodburners do emit small particles of smoke which, if inhaled, can cause respiratory disease. This is the case even though designs have become cleaner in recent years. New woodburners have to comply with national environmental standards on smoke emission.

Pellet burners are a cleaner option. They burn compressed wood pellets which are made from sawmill waste, so burning wood pellets is a form of waste wood recycling. The pellets contain nothing but wood and resins.

Regional and local councils may further restrict the use of woodburners to reduce smog and improve air quality.

Heat pumps

Heat pumps are an extremely energy-efficient form of space heating and cooling. In New Zealand, most heat pumps installed to date have been installed to provide heating – cooling has been a secondary function.

Air-to-air heat pumps, the most common type, use refrigerant to absorb heat from one space and transfer it to another via a heat exchanger (often a fin or coil).

They are very efficient at converting energy to heat, typically producing about 3 to 4 times as much heat as the electricity they use (under optimum conditions).

Heat pumps are expensive to buy and install compared to portable heating and require holes to be made in the weatherskin of the home during installation. They also require annual maintenance.

Find out more about heating options:
www.smarterhomes.org.nz/energy/heating/

www.consumerbuild.org.nz/publish/materials/materials-heating.php

www.level.org.nz/energy/space-heating-and-cooling/

Find out about energy saving tips for home heating:
www.smarterhomes.org.nz/energy/heating/energy-saving-tips-for-home-heating/

Which heating system is right for your home?

Decide which insulation level most likely matches your home. Then choose the column that best fits the area you want to heat – the whole house or just the living areas.

UNINSULATED	
Whole house We recommend: ▪ Heat pump ▪ Flued gas heater[1] ▪ Pellet or low-emission wood burner[2] ▪ Central heating – heat pump or gas ▪	**Living area** We recommend: ▪ Heat pump[1] ▪ Flued gas heater[2] ▪ Pellet or low-emission wood burner
CEILING AND UNDERFLOOR INSULATION ONLY	
Whole house We recommend: ▪ Pellet or low-emission wood burner[2] ▪ Central heating – heat pump or gas	**Living area** We recommend: ▪ Heat pump[1] ▪ Flued gas heater[2] ▪ Pellet or low-emission wood burner
FULLY INSULATED	
Whole house We recommend: ▪ Flued gas heater[1] ▪ Nightstore ▪ Pellet or low-emission wood burner[2] ▪ Central heating – heat pump or gas ▪ Underfloor heating	**Living area** We recommend: ▪ Flued gas heater[1] ▪ Nightstore ▪ Pellet or low-emission wood burner[2] ▪ Heat pump ▪ Central heating – heat pump or gas ▪ Underfloor heating ▪ Radiant or convection heater [3]

[1] Not open fire type.
[2] If neccessary, supplement with portable convection heaters, especially in bedrooms.
[3] Only suitable if you are heating for short periods.
Source: EECA

WHERE TO FIND OUT MORE

There are many guides to help you find out more about sustainable building design and materials.

Smarter Homes is a large and comprehensive site created for the Ministry for the Environment by a team including the Consumers' Institute, Beacon Pathway Ltd, URS and Creo, with assistance from other organisations interested in helping consumers access good quality, reliable and independent information about smart homes. It is now run by the Department of Building and Housing.
http://www.smarterhomes.org.nz/

ConsumerBuild provides a range of clear, independent and up-to-date information on building, buying, renovating and maintaining houses in New Zealand. This large and easy-to-follow website was developed jointly by the Department of Building and Housing and Consumers' Institute, with assistance from other organisations who have an interest in helping consumers.
http://www.consumerbuild.org.nz/publish/

Level is a website that provides practical, easy-to-understand information and advice on designing and building homes which have less impact on the environment and are healthier, more comfortable, and have lower running costs. The site was developed for the construction industry by BRANZ Ltd, the independent research, testing, consulting and information company.
www.level.org.nz/

BRANZ Ltd offers publications and resources in sustainable construction, including an Easy Guide to Eco-Building and the Green Home Scheme, a procedure for auditing new houses, rating environmental, health and safety issues.
www.branz.co.nz/main.php?page=Sustainable%20Construction

Home Energy Ratings scheme - have your plans or property assessed.
http://www.energywise.govt.nz/yourhome/home-energy-ratings/index.html

The Consumers' Institute website contains the results of independent tests on insulating materials and heating appliances, whiteware, etc. A subscription is required to access detail of reports, but some excerpts and factsheets are offered free. Public libraries have copies.
www.consumer.org.nz/

In some areas in New Zealand, schemes have been initiated to insulate homes, with subsidies. The Energy Efficiency and Conservation Authority website has details, along with information on how to select energy efficient appliances.
http://www.energywise.govt.nz/why-be-energy-efficient/be-warmer-and-healthier

Standards New Zealand produces *Subdivision for People and the Environment*, guidelines to assist environmentally sensitive land development, plus standards for energy efficiency, wastewater management and other housing issues.
www.standards.co.nz

The Window Efficiency Rating Scheme (WERS) is an independent guide that ranks the energy performance of windows. Brochures are available from many glaziers.
http://www.wanz.org.nz/

Building Comfortable Homes provides information on building with concrete. The handbook is available for $22.50, from Cement and Concrete Association NZ, Freepost 94722, PO Box 448, Wellington. (Phone 04 499 8820) An associated publication is *Designing Comfortable Homes*, also $22.50. Sample pamphlets are available from
www.cca.org.nz/toplevel_files/welcome.htm